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## Claims

What is claimed is:

- 1. A spectrometer comprising:
- 5 a transducer having a relative spectral resolution  $\rho_T \ge 0.0001$  and including:
  - a dipersive element for dispersing light,
  - a photodetector for converting light dispersed by the dispersive element into an
  - electrical signal representative of a measured spectrum, and
  - an analogue-to-digital converter for converting the electrical signal into spectral
  - data  $\{\widetilde{y}_n : \text{and},$

a processor for enhancing resolution of the spectral data  $\{\tilde{y}_n\}$  to provide spectral data  $\{\hat{x}_n\}$  having a relative spectral resolution  $\rho_p \leq \rho_T^{'}/2$ .

- 2. A spectrometer as defined in claim 1 wherein  $\rho$  = (absolute spectral resolution (nm)) / (wavelength range of spectral analysis (nm)).
- 3. A spectrometer in claim 2 wherein the transducer comprising a light diffraction grating has a relative spectral resolution  $\rho_T \in [0.0001, 0.02]$  and wherein the spectral data  $\{\hat{x}_n\}$  provided by the processor has a relative spectral resolution  $\rho_P \leq \rho_T / 5$ .
- 4. A spectrometer as defined in claim 2 wherein the transducer is absent means for performing optical signal processing of light other than the dispersive element.
  - 5. A spectrometer as defined in claim 2 wherein a single integrated component comprises the transducer.
  - 6. A spectrometer as defined in claim 5 wherein the single integrated component further comprises the processor.

- 7. A spectrometer as defined in claim 2 wherein the processor comprises calibration means for receiving spectral information relating to a known spectrum  $\{x_n^{cal}\}$  and for storing the data relating to the measured spectrum and the known spectrum in memory.
- 8. A spectrometer as defined in claim 7 wherein the processor comprises calibration means for receiving spectral data {v<sub>n</sub><sup>cal</sup> representative of the known spectrum {x<sub>n</sub><sup>cal</sup>}, for choosing a form of an ideal peak v<sub>s</sub>(λ,l) and of projection operator G and reconstruction operator R, for pre-processing the data {v<sub>n</sub><sup>cal</sup> for determining parameters p<sub>G</sub> of projection operator
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and parameters  $\mathbf{p}_R$  of reconstruction operator  $\mathcal{R}$ , and for storing in memory data relating a measured spectrum  $\mathbf{x}(\lambda)$ to its known and substantially idealised spectrum  $\mathbf{s}(\lambda)$ .

- 9. A spectrometer as defined in claim 8 wherein the processor is customised for use with the transducer.
- 10. A spectrometer as defined in claim 7 wherein the processor comprises: means for estimating a vector of positions of peaks 1 within a measured spectrum of a sample in dependence upon an estimate  $s(\lambda)$  of a known idealised spectrum  $s(\lambda)$  of a same sample; means for estimating vector of magnitudes of the peaks a; and, means for iteratively correcting the estimates of the vector of positions of the peaks and the vector of the estimate of their magnitudes.
- 11. A miniaturized spectrometric sensor comprising:
  a spectrometric transducer having a relative spectral resolution  $\rho_T \ge 0.0001$  and including:
  a port for receiving electromagnetic radiation for measuring a spectrum thereof,

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a dispersive element for receiving electromagnetic radiation received at the port and for dispersing the received electromagnetic radiation to provide dispersed electromagnetic radiation, and

a photodetector for receiving the provided dispersed electromagnetic radiation and for converting the dispersed electromagnetic radiation into an electrical signal representative of a measured spectrum of the electromagnetic radiation; an analogue-to-digital converter for converting the electrical signal into spectral data  $\{\widetilde{y}_n\}$ 

representative of the measured spectrum of the electromagnetic radiation; and, a processor for receiving the spectral data  $\{\widetilde{y}_n\}$ , for substantially enhancing the resolution of the spectral data  $\{\widetilde{y}_n\}$ , and for correcting some errors within those data in dependence upon stored data, the stored data relating the measured spectrum of electromagnetic

12. A miniaturised spectrometric sensor comprising:

a spectrometric transducer having a relative spectral resolution  $\rho_T \ge 0.0001$  and consisting of:

radiation of a known sample to a known reference spectrum for a same sample.

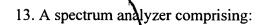
a port for receiving electromagnetic radiation for measuring a spectrum thereof, a dispersive element for receiving electromagnetic radiation received at the port and for dispersing the received electromagnetic radiation to provide dispersed electromagnetic radiation, and

a photodetector for receiving the provided dispersed electromagnetic radiation and for converting the dispersed electromagnetic radiation into an electrical signal representative of a measured spectrum of the electromagnetic radiation;

an analogue-to-digital converter for converting the electrical signal into spectral data  $\{\widetilde{y}_n\}$  representative of the measured spectrum of the electromagnetic radiation; and, a processor for receiving the spectral data  $\{\widetilde{y}_n\}$ , for substantially enhancing the resolution of the spectral data  $\{\widetilde{y}_n\}$ , and for correcting some errors within those data in dependence upon stored data, the stored data relating the measured spectrum of electromagnetic radiation of a known sample to a known reference spectrum for a same sample.

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a transducer having a relative spectral resolution  $\rho_T \ge 0.0001$  and including:

a dipersive element for dispersing light,

a photodetector for converting light dispersed by the dispersive element into an electrical signal representative of a measured spectrum, and an analogue-to-digital converter for converting the electrical signal into spectral data  $\{\widetilde{y}_n\}$ ; and,

a processor for enhancing resolution of the spectral data  $\{\tilde{y}_n\}$  to provide spectral data  $\{\hat{x}_n\}$  having a relative spectral resolution  $\rho_p \leq \rho_T/2$ .

- 14. A spectrum analyzer as defined in claim 13 wherein  $\rho$  = (absolute spectral resolution (nm)) / (wavelength range of spectral analysis (nm)).
- 15. A spectrum analyzer in claim 14 wherein the transducer comprising a light diffraction grating has a relative spectral resolution  $\rho_T \in [0.0001, 0.02]$  and wherein the spectral data  $\{\hat{x}_n\}$  provided by the processor has a relative spectral resolution  $\rho_P \leq \rho_T / 5$ .
- 16. A spectrum analyzer as defined in claim 14 wherein the transducer is absent means for performing optical signal processing of light other than the dispersive element.
- 20 17. A spectrum analyzer as defined in claim 14 wherein a single integrated component comprises the transducer.
  - 18. A spectrum analyzer as defined in claim 17 wherein the single integrated component further comprises the processor.
  - 19. A spectrum analyzer as defined in claim 14 wherein the processor comprises calibration means for receiving spectral information relating to a known spectrum  $\{x_n^{cal}\}$

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and for storing the data relating to the measured spectrum and the known spectrum in memory.

20. A spectrum analyzer as defined in claim 19 wherein the processor comprises calibration means for receiving spectral data  $\{y_n^{cal} \mid \text{representative of the known spectrum } \{x_n^{cal}\},$ 

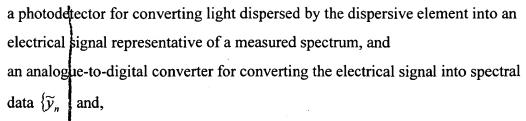
for choosing a form of an ideal peak  $v_s(\lambda,l)$  and of projection operator G and reconstruction operator R,

for pre-processing the data  $\{y_n^{cal}\}$  for determining parameters  $\mathbf{p}_{\mathbf{6}}$  of projection operator

- and parameters  $\mathbf{p}_R$  of reconstruction operator R, and for storing in memory data relating a measured spectrum  $\mathbf{x}(\lambda)$ to its known and substantially idealised spectrum  $\mathbf{s}(\lambda)$ .
- 21. A spectrum analyzer as defined in claim 20 wherein the processor is customised for use with the transducer.
- 22. A spectrum analyzer as defined in claim 19 wherein the processor comprises: means for estimating a vector of positions of peaks 1 within a measured spectrum of a sample in dependence upon an estimate  $s(\lambda)$  of a known idealised spectrum  $s(\lambda)$  of a same sample; means for estimating vector of magnitudes of the peaks a; and, means for iteratively correcting the estimates of the vector of positions of the peaks and

23. A spectrometer comprising: a transducer having a relative spectral resolution  $\rho_T \ge 0.001$  and including: a dipersive element for dispersing light,

the vector of the estimate of their magnitudes.



- a processor for enhancing resolution of the spectral data  $\{\tilde{y}_n\}$  to provide spectral data  $\{\hat{x}_n\}$  having a relative spectral resolution  $\rho_p \le \rho_T/2$  wherein  $\rho$  = (absolute spectral resolution (nm)) / (wavelength range of spectral analysis (nm)).
- 24. A spectrometer as defined in claim 23 wherein the dispersive element comprises a light diffraction grating having a relative spectral resolution  $\rho_S \in [0.005, 0.015]$  and wherein the spectral data  $\{\hat{x}_n\}$  has a relative spectral resolution  $\rho_p \leq \rho_S / 5$ .
  - 25. A spectrometer as defined in claim 23 wherein the transducer is absent means for performing optical signal processing of light other than the dispersive element.

